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ABSTRACT

Research since 1960 on the selection of students and the prediction of student success in occupational education is the focus of this review. In a systematic search of the literature, efforts were made to obtain identified materials. The review, written to serve both the researcher interested in bibliographical data, design and methodology, and the practitioner interested in applying data to ongoing, operational programs, includes descriptions of research studies in: (1) High School Student Selection and the Prediction of Student Success, (2) Post High School Student Selection and the Prediction of Student Success, and (3) Adult Student Selection and the Prediction of Student Success. Within these subjects, studies are classified as achievement studies (using grades, standard tests and/or teacher ratings or tests of program or course achievement as the principal outcome), completion studies (in which successful completion of the program is the principal outcome), or related student characteristics studies (in which the criterion variable was training, and/or occupational preferences, interest or other measures not classifiable as achievement or completion). The research is synthesized into a summary of the current status of knowledge about vocational-technical student selection and problem areas still in need of research. A bibliography is included. (GR)

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Review of Research on

STUDENT SELECTION and the PREDICTION OF SUCCESS in Occupational Education

by William E. Stock and Frank C. Pratzner

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AUGUST 1969

Minnesota Research Coordination Unit
in Occupational Education
University of Minnesota, Minneapolis, Minnesota

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FOREWORD

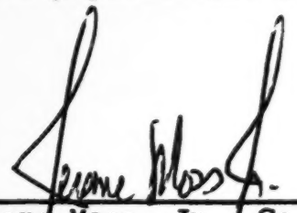
Knowledge about the individual student factors which make for "success" in vocational programs is obviously of great potential value to educators and employers. This review, which attempts a comprehensive assessment of the state of that knowledge, is therefore important to the profession.

That the authors' tasks was time-consuming and intellectually challenging can readily be inferred from the review itself. Their painstaking and highly professional response to the challenge are equally obvious.

Unfortunately, the review finds the state of knowledge disappointing. Much work has been done, but specific predictions are mainly inefficient and generalizable results are scarce. There is presently more to be learned from past failures than there is to apply to the conduct of guidance and selection programs. This is not to say that the account is bankrupt; only that the knowledge balance is low.

But the authors do provide some clues for further efforts. Perhaps the relationships are not linear. Perhaps different factors make for satisfaction and performance, and these also vary in relative importance at different stages of training. Perhaps we need to do more research using ultimate job performance rather than course performance as our selection criterion. Our simple solutions to prediction are unsatisfactory. The computer, however, is now available to us. We will need to take increased advantage of it in order to experiment with a greater range of dependent and independent variables in more complex relationships.

Finally, the authors introduce ideas for alternative "delivery systems" for providing guidance and selection services at the high school and post-high school levels. Their treatment is not detailed, but it does fill the "how" void so often left in the predominate psychometric discussions of "what".



Jerome Moss, Jr., Co-director
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INTRODUCTION

Accelerated enrollment in vocational-technical education in the past ten years has contributed to an awareness of the need for improved techniques for the selection of students and prediction of student success in occupational education. Expanding operating costs, shortages of instructional personnel, and a greater concern among educators for the sense of failure and frustration experienced by unsuccessful students have also served to call attention to the need for more effective ways of helping students find vocations in which they have the greatest possible chance of succeeding. The outlook for the future indicates that the problem will grow in importance.

Prior reviews of research relative to different aspects of the student selection/prediction of success problem(s) are particularly germane to this report. Patterson (1956) reviewed studies, conducted from 1921 to 1954, concerned with the prediction of success in trade and vocational school courses within an institutional setting (high school and post-high school). He reported the higher the skill level of the trade, the greater the relationship between intelligence and success in the course. It was further noted that manual dexterity did not appear to be a primary requisite for success. Certain tests, and certain types of tests, consistently showed significant relationships to success in trade school courses as measured by shop grades or ratings of shop work. In general, tests of verbal ability or general intelligence, visualization or spatial relations, and tests of mechanical experience (knowledge or information) were useful predictors. Tests of simple manual ability or dexterity did not appear to be effective predictors of course success. On the other hand, factor analysis of mechanical ability tests suggest that this ability consists of at least two factors, a visualization factor and a mechanical knowledge or experience factor, and probably a spatial factor is also present. These factors, together with general intelligence-- or its components--appear to be essential ingredients for success in trade school courses and continuing instrument development and testing would seem to be mandatory. For certain types of mechanical work (e.g. electrician, radar mechanic, machinist) tests of arithmetic or mathematics have also shown considerable validity. Apparently, the ability to acquire technical knowledge, to know when and where to apply it (with appropriate skill), and the ability to understand and plan a process or job seem to be the important variables in predicting training success for a skilled trade.

Patterson reported that almost no work had been done on the use of interest testing in the prediction of vocational course success, and that only one of the studies he had reviewed investigated the relationship of background and biographical factors to success in trade courses.

On the basis of his review, Patterson concluded that,

> . . . it should be possible to select a battery of tests which would combine to yield fair predictions of success in trade school training in any public or private school. The exact nature of such a battery might vary, depending on the level of training; and, possibly, upon the nature of the course. It would probably consist of a verbal intelligence test, a test of mechanical information or experience, a test of spatial ability, and possibly an interest test. For high school and post-high school training below the college level, an appropriate battery might be the AGCT, the Bennett AA, the Revised Minnesota Paper Form Board, and an interest test such as the Kuder Preference Record.

The Validity of Occupational Aptitude Tests is a report by Ghiselli (1966) of the validity of aptitude tests for predicting success in occupational training and on-the job proficiency. Ghiselli reviewed studies completed between 1919-1964 which employed samples of adults being trained for or employed on specific jobs. Two systems of job classification were utilized to relate tests to jobs: (a) The Dictionary of Occupational Titles (DOT) classification schema, and (b) a schema developed by Ghiselli, General Occupational Classification System (GOC). Validity coefficients for aptitude tests, based upon the average of the various tests for each job, were calculated when a sample of 100 or more cases was available for a particular test. Thus, validity coefficients for specific aptitude tests for selected occupational specialities were obtained.

Comparisons of the relative predictability of training and proficiency criteria compiled by Ghiselli showed training criteria to be relatively more predictable than on-the-job proficiency. Differences on the order of .10 between the average validity coefficients for training and proficiency criteria were found for most of the major occupational groups; intellectual, spatial and mechanical aptitude test coefficients were approximately .15 higher for training than for job proficiency, whereas the average validity coefficients for tests of perceptual accuracy and motor abilities were about the same for both types of criteria. In general, the abilities and traits which were important predictors of success in training were not very similar to those which predicted success in performance on the job. It would therefore appear that the tasks presented to those learning the skills and knowledges of the job bear little similarity to the factors that make for job success. Further, the ability and trait requirements for proficiency are quite specific to the job, while, on the other hand, the ability and trait requirements for training programs have some measure of generality across jobs.

The average correlation coefficient for predicting training success and job proficiency, for all occupations, was low (.14). However, correlations calculated by major occupational groups revealed higher correlations for clerical occupations (.39) than for trades and crafts (.17) and industrial occupations (.20). Ghiselli observed that skills and knowledges

learned in training for clerical occupations seem to have somewhat greater applicability to the job itself than is true of the trades and crafts and industrial occupations.

Prediger, et al., (1968) reviewed selection/prediction studies completed between 1954 and 1967. Their report was limited to studies of high school level vocational education programs and to predictors of cognitive and motor abilities. A modified form of Ghisellis' classification system was used in categorizing predictors (tests) and, in addition, eleven program categories were established with the students' grade point average in vocational courses serving as the criterion of success. Median correlations between tests and vocational programs were computed when a composite of at least two studies involving 100 cases (minimum sample size of twenty for any one study) were available.

The size of the correlations for specific predictors varied considerably among vocational categories. Evidence of this may be seen in the range of correlations for various predictors such as Arithmetic (.06 carpentry -- .48 business education), Verbal Intelligence (.14 carpentry -- .44 business education and bookkeeping), Non-Verbal Intelligence (.11 bookkeeping -- .46 home economics), Space (.15 bookkeeping -- .42 drafting), and Mechanical (.11 bookkeeping -- .44 machine shop). The degree of relationship between tests and vocational categories was found to be substantially higher for vocational areas generally oriented toward girls than for those oriented toward boys. For example, success in some vocational programs, notably shorthand and business education, seemed to have greater predictability than success in auto mechanics, carpentry and electricity. Verbal-Intelligence (IQ) was among the top two predictors in only 3 of the 11 areas studied and was therefore not concluded to be a prominent predictor of success. Perceptual Aptitude and Dexterity also appeared negligible in their contribution to the prediction of success. In general, their findings tend to support those of others, particularly Patterson's findings regarding the relative ineffectiveness of motor ability tests as predictors of success in vocational programs.

This review is an attempt to report and synthesize research efforts relative to the selection of students and the prediction of student success in occupational education which have been conducted since 1960. While no claim is made that the review is all inclusive, a systematic search of the literature was undertaken and efforts were made to obtain identified materials either in their original or abstracted form. It should be noted that several studies are included in the bibliography which are clearly outside the occupational education field. (Studies of students in college level engineering and technical courses are an example.) They were included, however, because of findings relevant to occupational education.

The review has been written to serve both the researcher who is interested in bibliographical data, design and methodology, and the practitioner whose interest is in the application of the data to ongoing, operational programs. It is hoped that it will, in fact, prove to be valuable to both groups.

SECTION I

Overview and Synthesis of Research

Summary and general remarks are necessary because of the diversity of instruments, methodologies, samples, and populations used in the studies reviewed. For the same reason, the conclusions must be interpreted cautiously. Several points of a general nature will be summarized to a) indicate the current status of knowledge about vocational-technical student selection/prediction, and to b) point out persistent problems and problem areas where additional research is needed.

It seems apparent that aptitude testing alone is not the whole answer to the student selection/prediction problem(s). Available evidence indicates that other variables, such as interest and motivation, act to influence student behavior in vocational education programs. While studies of non-intellectual factors generally have not provided the empirical evidence needed to predict outcomes with a high degree of accuracy, it seems reasonable that, in the development of better means of prediction, these variables must be studied or controlled. This in turn implies that more effort will be required to identify and measure non-intellectual variables relevant to vocational behavior.

Many of the studies reviewed were undertaken to complete the requirements for graduate degrees. While the dissertation provides a valuable source of information it is also usually accompanied by limited resources, time, and proficiency. More systematic, longitudinal efforts of the nature of PROJECT MINI-SCORE would seem to be required to get at solutions to the selection-prediction problems confronting vocational education.

The data seem to support the contention that certain types of tests consistently operate more successfully as predictors than do others. One such test, the General Aptitude Test Battery (GATB), has been subjected to numerous investigations and seems to have application to many vocational-technical curriculums.

Attention should also be called to the fact, noted by other reviewers as well, that the value of a given test as a predictor may change over time. Tests which are effective predictors of success in the initial stages of training may be of little value in later stages of training and predictors of success on-the-job; the latter, however, may be due to differences in the characteristics required for success in the two situations.

The review seemed to confirm the findings of previous reviews (i.e., Patterson, Ghiselli, Prediger) that, in general, motor ability tests are of negligible value in the selection-prediction process. In fact, it would appear that an inverse ratio exists between the level of the trade or occupation trained for and the effectiveness of motor ability tests as predictors. The best predictors of future performance in training programs, cognitive as well as non-cognitive, have typically been intellective measures of cognitive ability (e.g. I.Q., reading, arithmetic) and/or measures of past academic achievement in the "solid subjects" (e.g. English, mathematics, etc.).

While many studies have successfully employed regressional techniques to identify selected variables for the prediction of variously defined training outcomes, few took the additional step of reporting (or perhaps the prior step of investigating) whether the regression equations and/or predictors identified through the regression equations were actually adopted and successfully utilized to effect student selection and guidance procedures or program changes. For example, it is important to know whether utilization of the data from such studies actually made a difference in outcomes (in a reduced dropout rate, increased program holding power, increased subsequent employment success, improved GPA's etc.).

Correlation and regression studies have typically found that three or four variables provide nearly as much information as a larger number. Also, attention should be drawn to the fact that low correlation coefficients do not necessarily mean that a given aptitude is not important to success in a vocational program. One should not interpret low coefficients between predictor variable and performance to mean that the aptitude in question is unnecessary. It may in fact mean that all subjects have about a minimum level of the aptitude, and consequently it does not differentiate between successful and unsuccessful subjects.

Utilization of the "achievement", "completion", "student characteristics" classification schema for the review reflects a convenient grouping of studies on the basis of principal program outcomes investigated, an approximation of the relative effectiveness of groups of potential predictors, and a rough estimate of the emphasis of prior research.

Entries in Table 1 are the numbers of studies which have been reported in the text of the review and identified in the Bibliography.[1]

Table 1

NUMBERS OF PREDICTIVE STUDIES REPORTED IN THE REVIEW

		Program Outcomes		
		Achievement	Completion	Related Student Characteristics
Student Groups	High School	13	3	3
	Post-high School	25	12	3
	Adult	0	4	8
	Total	38	19	14

[1]The format of the Bibliography was also adapted to facilitate a problem-centered search of relevant literature.

The following remarks summarize and synthesize pertinent findings of the review in terms of the Program Outcomes identified in Table 1. Summaries of research relative to Student Groups shown in the table have been reported in Section II.

Prediction of Achievement

The number of studies in which achievement was employed as the principal program outcome indicates that more effort has been expended on it than on the other outcomes. This is not surprising since available instruments and methodologies lend themselves readily to this type of outcome; the time necessary to conduct a study of this type is generally shorter, and the outcomes to be measured and/or predicted are usually clearly defined and readily available.

The need for a programmatic approach to the study of achievement prediction was apparent; the most obvious similarity among studies of achievement was in data collection and analysis. On the other hand, research on nursing training was exemplary of the more systematic approach needed.

High school industrial arts scholastic achievement was reported to have an observable influence on the scholastic achievement of students in specific post-high school vocational programs. Academic variables were found to be more highly correlated with achievement in technical programs than were biographical variables. In several studies, information from high school records, such as high school rank, or GPA, was found to be an effective predictor. While data from the American College Test was found to have validity for predicting the performance of students in two year occupational-terminal curricula, the level of predictability was not as high as that typically obtained for students in academic curricula.

High school rank (or high school GPA) was prominent as a predictor of academic achievement in nursing training, although it was much less efficient in predicting second-year dropouts than first year dropouts. Certain variables were found to have significant value in predicting grades in specific courses in the nursing training program. In general, ward performance was the most difficult aspect of the program to predict. Achievement and aptitude measures were better predictors of success than were personality measures.

Prediction of Completion

Arithmetic achievement or test scores were identified as relatively effective predictors in a number of studies of program completion, while the Differential Aptitude Test battery appeared to have differential usefulness for predicting successful completion of vocational-technical programs. At the high school level, ninth grade attendance, ninth grade combined academic average, age at entry into the program, and intelligence scores were among the better predictors of program completion. The paucity of studies, however, indicates that further efforts are necessary to validate these findings.

The most noticeable difference between studies predicting achievement and those predicting completion was a greater use of non-intellectual variables in the predictor equations for completion. This trend on the part of

many investigators indicated that other factors, in addition to past achievement and aptitude, were considered of added importance when the criterion investigated was program completion. The problem appeared to be a matter of determining what factors to measure, identifying or developing instruments for measuring them, and determining the weights or relative emphasis to be given to the factors.

More specifically, interest and interest related factors were useful for differentiating between students who changed programs and those who completed or withdrew from a two year technical and associate degree college. The Minnesota Vocational Interest Inventory (MVII) was reported to have distinguished potential candidates likely to complete industrial arts teacher education programs, and it was reported to be a useful instrument in a longitudinal selection study of post-high school vocational-technical school students in Minnesota. Grade-expected-in-course was found to be the best predictor of training success in one study, while student "motivation" was an important variable in other studies of completion. By contrast, high school achievement by itself did not prove to be of much practical significance in predicting program completion.

A small number of studies investigated program completion variables for adult vocational-technical students. A follow-up study of Wisconsin high school graduates, seven to eight years after graduation, indicated that almost twice as many graduates had attended vocational schools as had originally planned to do so. A study of MDTA programs found that aptitude test batteries now in use by local Employment Service offices have validity for prediction of success of MDTA training candidates. A second study of MDTA students investigated combinations of personal information and General Aptitude Test Battery scores to predict trainees who would drop out or complete training. Important conclusions of the study were that both skills and attitudes were related to successful employment, and different selection criteria were necessary for placing trainees in different types of occupational programs.

Prediction of Student Characteristics

Research relative to related student characteristics has, in the main, assessed the utility and validity of non-intellectual instruments for selection/prediction purposes. The results encourage additional research efforts, and emphasize the overriding need for philosophical bases and theoretical constructs to facilitate a systematic attack on immediate problems of student selection.

Table 1 indicates relatively few studies of related student characteristics for high school and post-high school students, and a relatively larger number for adults. Moreover, none of the adult studies were classifiable as achievement studies.

These findings suggest that, in general, a) investigators differentially weight or attribute degrees of importance to the two independent variables for groups of students, b) the probability that differential importance reflects to some extent degrees of sophistication in instrumentation and ease of measurement, and/or c) that related student characteristics (e.g. training/occupational preferences, interests, motivation, etc.) are in fact

investigated, but well-developed theoretical constructs to relate long-term "pure" research to more immediate and practical applications are not available.

Both achievement and completion studies reflected a concern for the relative efficiency and effectiveness with which institutions selected students. Related student characteristic studies, on the other hand, appeared to be more concerned with the relationships among student attributes and the selection of programs (and institutions) by students. Thus, for updating and retraining purposes, the characteristics of adult groups to be served, reasons for selecting particular programs, and forms of desired training were more important variables for institutions than data predictive of achievement or program completion.

The Minnesota Vocational Interest Inventory, Kuder Preference Record, and Hackman-Gaither Vocational Interest Inventory have all shown limited usefulness for predictive purposes. Student interest seems to be an important occupational entry variable, while the importance of other personality attributes was found to vary among studies. In a study involving work satisfaction, "freedom" and "intellectual stimulation" were reported as the most prominent reasons for work satisfaction; "lack of appreciation by colleagues and administrators" and "bad physical working conditions" were the main reasons given for dissatisfaction.

Several studies utilizing the Strong Vocational Interest Blank have shown expressed interests of twelfth grade students to be relatively stable and valid indices of later interests and even occupational choice. However, other research suggested that job satisfaction was not necessarily related to interests appropriate to the occupation.

In conclusion, it seems imperative that systematic, longitudinal approaches to selection/prediction problems be undertaken. Baker has suggested a number of characteristics of large-scale developmental projects of the sort being suggested which clearly imply that the task is indeed a formidable one. Among the troublesome characteristics are the following:

> . . . a large-scale [developmental] project deals with a problem area rather than a specific problem, the problem itself is ill-defined, a univariate criterion variable such as yield or cost is not readily available, an interdisciplinary team of researchers is involved, a management hierarchy exists which needs research guidelines . . . and classical experimental designs do not appear to possess the capabilities necessary to cope with research projects possessing these characteristics.[2]

That tests be utilized and their uses studied, not only for selection purposes but for inter-institutional cooperative student guidance, also seems imperative. A multiple-yield concept or approach to the use of test instruments and current selection devices is recommended. More sophisticated

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[2]Baker, F. B. "Experimental Design Considerations Associated With Large-Scale Research Projects," in Improving Experimental Design and Statistical Analysis. 7th Annual Phi Delta Kappa Symposium on Educational Research, Chicago: Rand McNally & Company, 1967, pp. 226.

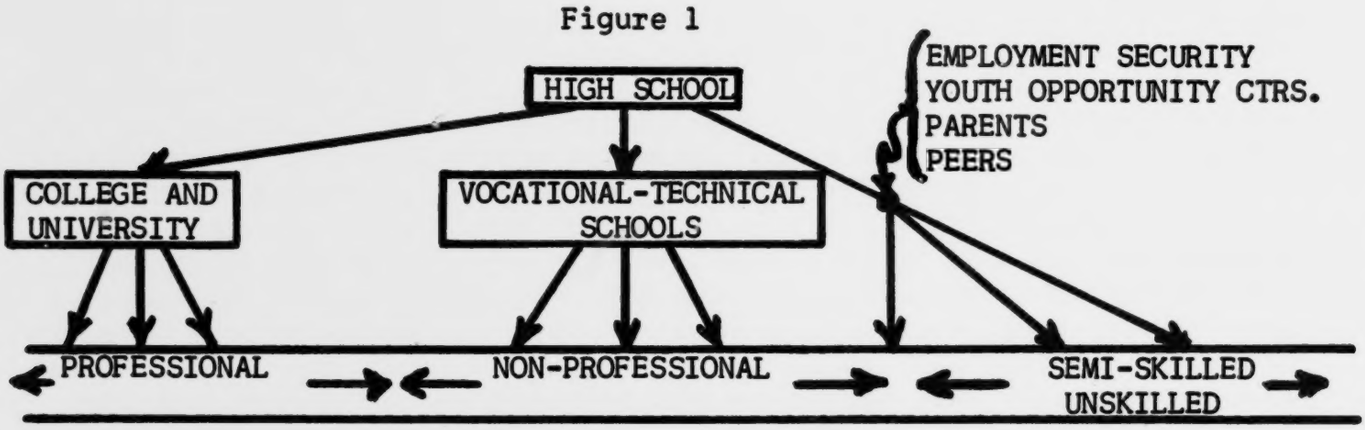
student selection systems would then provide applicants with aptitude, ability, interest and other test interpretations, remedial help in areas of deficiency, and finally programs compatible with applicant needs and capabilities. It should, on the other hand, provide vocational-technical institutions with competent students capable of mastery learning.

Installation of Alternative Selection-Guidance Systems

People prepare for careers and become employed in several ways. Colleges and universities prepare selected individuals for professional careers, vocational-technical schools select and train others for non-professional careers, and still others enter the labor force immediately after high school with no additional, formal preparation and become employed largely in semi-skilled and unskilled jobs. Subsequent to entry into the labor force, a confluence of conditions and variables result in job mobility and a degree of "work adjustment."[3]

Figure 1 summarizes alternative routes to employment and depicts obvious points at which post-high school training, selection and guidance typically occur.

Figure 1



Two Perspectives on Selection

The ameba-like dynamics of today's labor force would seem, at first glance, to suggest that the quality of vocational-technical offerings and the level of achievement of vocational-technical students in their chosen programs are probably more important student variables, in the long-run and in terms of future potential for mobility, than is the selection or choice

[3]Work adjustment refers to the process by which individuals interact and come to terms with their work environment as measured by "satisfactoriness" -- work adjustment viewed from the employer's standpoint--and "satisfaction" -- work adjustment viewed from the vantage point of the individual.

of particular vocational programs for initial employment. After all, education is a continuous, life-long process during which the influence of initial training diminishes somewhat in importance as new experiences accrue.

Individual selection of programs and institutional selection and guidance of students, however, continues to increase in importance, and even grows more problematic, as larger numbers avail themselves of formal vocational programs for preparation, updating and retraining.

Institutional Selection of Students

In the best of all possible worlds, vocational institutions would be expected to select and place applicants in training programs best suited to a) student abilities, interests and motivation, and b) societies' needs for optimum manpower utilization. In the real world, these two strategies for student selection are often incompatible.

Dunnette (1966) has pointed out the incompatibility of the two approaches to selection for large business and industrial corporations, but the analysis is also relevant to vocational training institutions. Assuming that adequately sophisticated and reliable instrumentation and selection techniques were available, a "pure selection" strategy (i.e., the most qualified person in each available position) would maximize the over-all effectiveness of the training institution, but it is inherently wasteful in that it would leave many applicants untrained and thus underutilized. On the other hand, a "pure vocational guidance" strategy (i.e., person placed in the occupational program for which he is most qualified) tends to ignore the fact that a limited number of training positions and jobs are typically available at a given time. Thus, a compromise strategy (using elements of both selection and guidance) is usually followed by an institution in the selection and placement of available persons as wisely as possible. Typically there are no rigid rules to follow to assure optimum placement, and Dunnette characterizes the strategy as a "cut and try" judgemental approach.

Student Selection of Programs

Students do not select, seek out, and enroll in vocational training programs independently. The interrelation between student program selection and institutional student selection has briefly been suggested above, and a variety of other social-environmental-experience variables influence the choices which students make at a given point in time. Briefly summarized, these include: a) knowledge of existing opportunities for training, requirements for entry, rewards offered, opportunities for subsequent employment and advancement, and b) knowledge of, or feelings about, their own abilities, interests, prior education, and personal value system (e.g., attitudes concerning income, prestige, working conditions, etc.).

Recognizing a degree of oversimplification, the program selection process of the student can probably be characterized as ". . . a descent in a hierarchy of preferences which comes to an end, at least temporarily, when a student is admitted to a (training) program" (Blau, et al., 1966).

Each of the above perspectives on selection appears to involve a strategy for internal compromise and certainly a compromise has been affected when students enter a vocational training program. The latter compromise is facilitated by the vocational guidance process which, in the context of vocational schools, ideally implies a) professional assistance in the choice of an occupation and appropriate training institution, b) preparation for entry into the occupation, and c) identification of openings and placement in the occupation.

That most students need and can benefit from guidance and assistance in the determination of their vocational goals and selection of appropriate vocational programs, and that vocational schools need to exercise some form of selection are not debatable. What is open for discussion (and subject to investigation) are alternative ways in which guidance and selection can be improved. Forty-odd years of research on student selection/prediction of success attests to persistent and current inadequacies at the high school, post-high school and adult levels. The 1968 Amendments to the Vocational Education Act of 1963 have also focused attention on the problem(s), and authorized federal monies to stimulate and facilitate a concentrated effort toward their eventual solution.

Adequate vocational student selection and guidance systems require large-scale, developmental efforts which further necessitate substantial institutional investments in skilled counselors and personnel managers, system hardware and operation, and the development and improvement over time of such software as instrumentation and measurement devices and techniques. At this level of planning and operation, several alternative approaches to selection and guidance systems can be described.

Alternative Approaches to Selection and Guidance

Improvement of Existing Programs

Many area vocational-technical schools employ at least one full-time guidance counselor, and frequently additional school personnel are responsible for selection and applicant testing, student affairs, coordination of extra-curricular activities and job placement. Additional regular and personnel guidance functions are also inherent in the classroom and laboratory interactions among instructors and students.

What can be done to improve the efficiency and effectiveness of existing selection-guidance programs in vocational schools? Qualified, well-trained, professional counselors in every school are obviously important.

Through cooperative work experience programs or practicum requirements, students in college and university guidance and counselor training departments might also provide paraprofessional assistance to vocational institutions. Paraprofessionals could be used for test administration, applicant interviewing, selected case work, workshop and small group instruction (e.g., instruction on job application techniques for students seeking initial employment), study and report on job opportunities and local labor market characteristics, and a variety of other services.

Coordination and long-range planning are necessary among personnel directly responsible for student selection and guidance. A variety of tests, inventories and other selection materials periodically become available and their potential usefulness necessitates review and study. Follow-up data on graduates must be systematically gathered and local test norms should be developed and studied.

The objectives, methods and data of PROJECT MINI-SCORE[4], conducted in Minnesota, can be a useful prototype for the development or adaptation of other systems to a) gather cross-sectional and longitudinal data on students, training outcomes and work history, and b) apply the findings to the selection and counseling of prospective students.

Vocational institutions should provide extensive in-service staff training on the role, functions, and methods of guidance and counseling. Individual instructor assistance with particular student problems should be supplemented with a carefully planned sequence or program of group instruction and workshops designed for continuous staff improvement. In-service training might be managed by the school counselor with the assistance of appropriate paraprofessionals and/or selected administrative or instructional staff with special background or prior training.

Inter-Agency Approach

A single selection, guidance, and placement agency cooperatively supported and utilized by area vocational-technical schools throughout a state, (or large regions within the state), is one alternative or supplement to improved guidance programs in each vocational school. While a cooperative, consolidated approach might include all of the advantages and limitations of large corporations, it should minimize duplication of facilities, staff, and effort inherent in current practices.

Applicants to the vocational schools are referred to the central agency for interviewing and testing. The applicants' vocational plans and training objectives are thoroughly assessed and applicants either enrolled in appropriate institutions and training programs, or referred to short-term remedial training at the center. Remedial training would be in order if a) an applicant

[4]See pp. 31-32 of the review.

desired a vocational program but was judged to need preparatory, updating or corrective work in order to benefit from the intended program, or b) interview and test data suggested serious incongruencies between the expressed training desires of the applicant and his ability to benefit from such training. In the latter case, remedial work is recommended as an exploratory guidance technique, used along with counselor interpretation of available information about the applicant, to eliminate incongruencies (i.e., change applicant aspirations, or change the form of training).

A single (or central) agency approach to selection, guidance, and placement seems to have economic advantages and provides for more effective recruitment, utilization, and coordination of staff. A well-trained staff of counselors with advanced degrees and/or different areas of specialty should result in the stimulation of new ideas and facilitation of projects, while permitting more extensive, detailed work with applicants. It should also provide an attractive opportunity to counselor training departments for student practicum and cooperative work experience. The center would benefit economically from a relatively inexpensive and professional staff. Moreover, the trainees would provide a source for new ideas and information about current developments in the field and facilitate the conduct of new research.

A center, of the sort being suggested here, could efficiently and effectively utilize data from projects like MINI-SCORE, and seems to be almost a necessity for the implementation of computerized vocational decision systems like the "Information System for Vocational Decisions" (ISVD) and the related MONITOR control system currently being investigated and developed by Tiedeman (1968) and others at Harvard University.

Secondary School, Pre-Vocational Approach

When students present themselves at the vocational school, a great deal of occupational information has been acquired (some accurate and some inaccurate) and many occupational decisions and vocational plans have already been made. Counseling at that point is, more-or-less, post-facto counseling. The extent to which prior decisions lead in less efficient directions, or necessitate changes due to failure and frustration, is indicative of an absence of or ineffective guidance and counseling.

Although precise estimates of when people are most susceptible to having their vocational choices manipulated are not available, Holland (1968) has pointed out that a person's expressed choice of vocation becomes more stable from childhood to adulthood. Consequently, Holland concludes it is reasonable that adolescents are more vulnerable to influence than young adults.

> ...Similarly, a person's educational aspiration and his level of occupational choice are probably more amenable to manipulation at lower rather than higher age levels.

The Vocational Education Amendments of 1968 are replete with directives calling for guidance and counseling programs for vocational education which,

> ...individually or through group instruction...facilitate occupational choices; instruction related to an occupation or occupations for which students are in training or instruction necessary for students to benefit from such training.

Exemplary programs will be supported which,

> ...broaden occupational aspirations and opportunities for youth...familiarize elementary and secondary school students with the broad range of occupations for which special skills are required and the requisites for careers in such occupations...provide intensive occupational guidance and counseling during the last years of school and for initial job placement.

A secondary school occupational orientation or pre-vocational approach could reduce the need for highly trained counselors in post-high school vocational institutions so that experienced personnel workers could concentrate on meeting the on-going counseling needs of students and coordinate job placement activities. Carefully planned and coordinated secondary school experiences, such as part-time work opportunities, a sequenced diversity of classroom and laboratory activities, field trips, and small group and individual counseling sessions to explore student characteristics as they relate to career plans and occupational realities should be jointly managed by school counselors, special subject teachers and extra curricular personnel. Students leaving the 12th grade should have had the opportunity and assistance necessary to develop a more-or-less explicit "career plan" and be aware of alternative ways to implement such a plan. They should be aware of the kinds of additional training, skill development, or academic preparation needed, and how and where it can be acquired.

Summary

Extensive research on vocational student selection/prediction of success has pointed out the need for improvements in current practices. Institutional and student viewpoints on selection have been described and three approaches to the improvement of selection and guidance were proposed.

Suggested improvements of existing programs included: a) full-time certified counselors in each school, b) utilization of paraprofessional assistants, c) program coordination, long-range planning and graduate follow-up, and d) extensive in-service staff training in guidance and counseling techniques.

A single selection, guidance and placement center for a state or region within a state was described which would pool guidance and counseling resources and staff to provide vocational school applicants with indepth test interpretation, counseling, and short-term remedial training when necessary. It was further suggested that such a center would have built-in mechanisms for generating new ideas and facilitating new research efforts.

Finally, since many occupational decisions are made and career plans begun prior to post-high school vocational training, a secondary school pre-vocational approach to selection and guidance was outlined. High school work experiences and classroom activities to explore occupations, develop career plans, and determine future training and appropriate skill development opportunities were suggested. Federal support for such a program was illustrated by reference to selected portions of the Vocational Education Amendments of 1968.

SECTION II

CLASSIFICATION & REPORT OF STUDIES

The classification schema used in the review resulted from several attempts to develop a systematic and meaningful plan for categorizing studies. The schema adopted provides for organizing studies on the basis of (a) the samples employed in the studies and (b) the principal program outcomes or dependent variables investigated (e.g., Secondary School-Achievement). Studies were classified under the secondary school category if they employed a sample of junior and/or senior high school subjects; the post-high school category was used when the samples consisted of students in post-high vocational-technical programs, nurses' training, or college level engineering and technical programs; studies were classified in the adult category if they employed samples of subjects in company training programs, adult retraining or employed adults in specific professional or vocational situations. The studies were then further classified according to their principal dependent variable. Achievement studies refer to studies using GPA, standard tests and/or teacher ratings or tests of program or course achievement as the principal outcome. Completion studies denote studies where the principal outcome was successful completion of a program or course of study. Related student characteristics studies were those wherein the criterion variable was training and/or occupational preferences, interest, or other measures not classifiable as achievement or completion.

HIGH SCHOOL STUDENT SELECTION AND THE PREDICTION OF STUDENT SUCCESS

Achievement Studies

A number of studies conducted in vocational high schools have investigated a variety of instruments and techniques for predicting academic achievement or grade point average. Several studies have used the General Aptitude Test Battery (GATB), or portions of it, as a predictor, while some have involved the use of other standardized tests, teacher-made tests, or biographical data. In general, the studies provide data concerning effectiveness of a variety of devices for predicting vocational high school achievement.

Traxler (1966) used the GATB in a study designed to determine its usefulness as a predictive instrument for counseling and placement in a

technical-vocational high school. A comparison of zero-order correlations between test data from the GATB and grades in English, social studies, core area, and overall grade point average (GPA) revealed that (a) the predictive validity of the GATB was equally high for male and female samples, (b) the GATB was not equally valid in predicting success in all subject areas; greater predictive ability was obtained in core areas where success was more dependent upon manual than verbal abilities, and (c) the GATB can be considered a useful instrument in counseling and in placement because it is a multi-factor test which lends itself to aptitude profiling.

Another study (Tate, 1965) investigated (a) the relationship between the GATB and the achievement of eleventh grade students in selected vocational-technical courses, and (b) the relationship between the vocational-technical course grades of the study sample, and GATB test norms established by the Bureau of Employment Security, as well as test norms developed in the study. A significant relationship was found between GATB aptitude scores and selected vocational-technical course grades. No significant relationships, however, were found between grades and the two sets of test norms.

Multiple regression analysis was used by Ingersoll and Peters (1966) in a study entitled "Predictive Indices of the GATB." Four thousand ninth and tenth grade boys and girls enrolled in forty-two subject matter courses in twenty-one selected Ohio schools comprised the sample. The dependent variables consisted of the Point Hour Ratio (PHR) and the single subject grades at the end of one year; the independent variables were the nine aptitude scores of the GATB. Relevant findings of the study were as follows: (a) the multiple correlation between 10th grade Home Economics grades and Verbal, Numerical, Spatial and Clerical Perception was .492 (all aptitudes significantly correlated); (b) Form Perception and Verbal Aptitude were significant contributors in the 10th grade mechanical drawing equation (R = .621), but Motor Coordination (K) was a negative contributor in the analysis; (c) ninth grade vocational and business course grades were significantly predicted in most instances from aptitudes of the GATB (R from .428 to .781).

A variety of factors effect the ultimate utility of any predictive device. The effect of maturation (the growth process) on predictive accuracy is perhaps among the most difficult variables to study. For aptitude measures to be used with confidence as predictive devices for a particular sample, there must be evidence of their stability over time. A longitudinal study investigating the effect of maturation on GATB aptitude scores for high school boys and girls (Droege, 1966) found increases in mean scores attributable to maturation for all GATB aptitudes measured at the 9th, 10th, 11th and 12th grades. The increases were similar for boys and girls and, as might be expected, the largest increase due to maturation was between the 9th and 12th grades. Profiles of stability coefficients (i.e., product-moment correlations between initial test scores in earlier grades and retest score in 12th grade) revealed that the coefficients for all nine aptitudes were highest for 11th grade and lowest for 9th grade.

Aptitudes with the highest stability coefficients were Intelligence, Verbal Aptitude and Numerical Aptitude, while Form Perception and Finger Dexterity had the lowest coefficients.

Instruments other than the GATB have been used as predictors of achievement in high school vocational education courses. Scores from the National Aptitude Survey Test were used by Kaltsounis (1965) in a study of ninth grade male students in Michigan and Ohio. Twelve predictors were developed for each individual based on a Number Right Score and Formula Score for six tests: Reasoning, General Vocabulary, Automotive Vocabulary, Chart Plotting, Game Playing, and Survey of Object Visualization. Criterion data were defined as marks for courses taken after testing. Multiple correlations for the eight largest criterion groups ranged from .507 for General Business to .316 for Bookkeeping. The general conclusions of the study were that (a) significant relationships existed between predictors and criteria, (b) the relationships usually improve when predictors are combined, and (c) relationships established on the large groups held true for other similar samples.

The relationships between selected junior high school grades and grades subsequently earned in five technical-vocational high school areas were the subject of a study by Long (1959). Junior high school grade averages in language arts, mathematics, social science, science, industrial arts, home economics, and standarized test scores for reading and IQ were related to technical-vocational high school course grades in multiple correlation analyses. The general findings and conclusions were that (a) the multiple correlations computed for each area, using all eight independent predictors, did not improve the significance of forecasting accuracy obtained by using only the three best predictors, (b) math GPA was the best over-all predictor of success for boys and girls, (c) social studies GPA contributed significantly to the prediction of success for boys but not for girls, (d) reading comprehension scores were one of the best predictors for boys and girls, and (e) science GPA was the poorest independent variable.

Miller (1966) reported a study in progress designed to identify a battery of predictive tests for use in selecting students in the trade programs in the vocational-technical schools of Connecticut. Standardized tests of aptitude, general achievement, mental ability, attitudes, and occupational interests comprised the predictive test battery. The criteria were technical competence, as determined by achievement instruments developed for each trade area and a performance test of shop skills. The original test battery has thus far been reduced in size, and test time has been reduced from twenty-one hours to less than fourteen hours.

The effectiveness of aptitude and interest measures as predictors of ninth grade woodshop performance was studied by Racky (1959). Predictors consisting of interest, aptitude, and personal information measures were related to woodshop performance based on the ratings of two projects and final semester grades. The battery of five tests consisted of a personal

data questionnaire, MacQuarrie Test of Mechanical Ability, Kuder Mechanical Interest, Kuhlman-Anderson I.Q., and age in months. Scores from the test battery, when correlated with woodshop performance, produced a multiple correlation coefficient of .686. Pertinent environmental information, (as measured by the personal data questionnaire), and mechanical aptitude, (measured by MacQuarries' Test of Mechanical Ability) had a higher correlation with woodshop grades than the other variables studied. It was concluded, however, that the predictive value of the test battery was not sufficiently high to justify its use for the selection or elimination of pupils, but that it was valuable as a diagnostic instrument for identifying those students likely to have difficulty in the woodworking course.

A similar investigation was undertaken by Croft (1959) in which a battery of tests (a clothing construction test, Miller Survey of Object Visualization, and Finger Dexterity Questionnaire) was successfully utilized to predict the clothing construction achievement of high school girls.

Casey and Heemstra (1965), interested in developing criteria for screening enrollees in a high school shorthand course, reported that I.Q., rank in class, English grades and total GPA were significantly correlated with the success criterion of letter grade rank in class. While these variables seemed to be good predictors, further investigation of their usefulness was suggested.

A review of criteria typically used for the selection of stenographic students (Seldon, 1961) reported achievement in grammar as the most reliable measure for prognosis of stenographic ability. It was emphasized, however, that as many other factors as possible should be considered in the selection of students.

A sample of 687 students from five representative Chicago high schools was used in a study reported by Di Bona (1960). The investigation dealt with the problem of predicting success in stenographic subjects. The instruments and measures used were the Turse Shorthand Aptitude Test, the ERC Stenographic Aptitude Test, average English grade scores, and average grade scores in other major subjects for freshmen and sophomore years. The criteria used were (a) Stenography 1 and Stenography 4 teacher assigned grades, (b) scores on a fundamental or theory-test given at the end of two semesters of shorthand, and (c) scores on a transcription test given at 80 and 100 w.p.m. at the end of Stenography 4. Apparent lower limit scores for student selection were: a score of 220 for the Turse Shorthand Aptitude Test, 90 for I.Q., and F+ grades (1.25 - 1.50 quality points) in English and in scholastic scores. The study concluded that "any willing student deserves to try out his potential abilities in shorthand, tempered with counsel and diagnostic help for weaker students," since personal factors, such as drive, enthusiasm and initiative, have a beneficial influence on the performance of both weak and strong students.

Doppelt, Seashore and Odgers (1959) investigated the Differential Aptitude Tests (DAT) to determine their usefulness for predicting the

success of auto mechanics and machine shop students. Comparisons were made between test performance of vocational groups, test norms presented in the DAT manual, and selected program variables. The criterion measure of success consisted of ratings on selected traits (understanding of trade information, job know-how, quality of work, and quantity of work) made by instructors. For auto mechanics subjects, there was no indication that an effective estimate of overall course success could be made from test scores. The most promising relationships among grade 11 ratings and tests were: (a) understanding trade information and spelling (r = .35), (b) quantity of work and abstract reasoning plus mechanical reasoning (r = .38), (c) total rating and abstract reasoning plus mechanical reasoning (r = .35). Twelfth grade auto mechanics students had the closest relationships between understanding trade information and abstract reasoning (r = .36). For machine shop students, one or more of the DAT tests were good predictors of all teacher ratings in grades 11 and 12. The sum of scores on abstract reasoning, space relations, and mechanical reasoning was recommended as a useful predictor of machine shop student course performance in both grades 11 and 12. The DAT seems to provide valuable information for counseling students considering enrolling in vocational machine shop courses. Expectancy tables showing the relationships among selected predictors and instructor ratings emphasized the value of test data for counseling and course selection.

Completion Studies

Studies of the factors related to or capable of predicting completion of secondary school vocational-technical programs have, in general, utilized standardized tests and/or biographical data.

A study by Whitten (1961) was conducted to identify a valid and reliable set of criteria to admit junior high school graduates to a vocational high school program. An all Negro sample of 613 boys and 250 girls, between the ages of 14 and 18 years, was used. Ten measures of academic ability and achievement were employed to predict persistence in the program, student achievement, and attendance. The best predictors for persistence in and graduation from the vocational-technical program were 9th grade attendance, 9th grade combined academic average, age at entry, and intelligence. Achievement of boys and girls in industrial arts/home economics, as well as intelligence and other course grades, were found to be significant predictors of achievement in the secondary vocational high school program. Ninth grade attendance was the best single predictor of vocational school attendance. In general, the selection of students using only the criterion of 9th grade attendance was only slightly less effective than utilizing a combination of all other factors.

Standardized test scores for intelligence, reading and arithmetic (Carlin, 1962) were used as predictors of completion in automotive, electrical, and woodworking courses in selected vocational high schools in New York City. Critical scores to discriminate between graduates and dropouts were determined for the three variables. The critical arithmetic score was shown to be the most efficient single predictor of completion

in these curriculums, with intelligence second and the critical reading score the least efficient. It was concluded that discriminant equations using the three variables (intelligence, reading, and arithmetic) were effective in predicting success for individual trades, combinations of trades within each school, and for the total sample.

Foote (1960) conducted a study of a three-year specialized automotive mechanics curriculum in a vocational high school in New York City to determine whether certain standardized paper and pencil tests and inventories could effectively predict achievement and graduation. Successful prediction of graduation from the program was facilitated by the use of three tests: the New York City Arithmetic Computation Test, Kuder Preference Record (Computational Scale), and DAT Mechanical Reasoning Test. The SRA Mechanical Aptitude Test, Kuder Preference Record (Mechanical Scales) and SRA Non-Verbal Form were also found to be useful and valid individual predictors of performance test scores. Arithmetic was the single most significant predictor of graduation, of two related technical subject term grade averages, and of continuance into the second half of the curriculum. Shop grade averages were the most poorly predicted criteria, and verbal IQ and Reading were both conspicuous by their failure to appear among the significant predictors of any criterion.

Related Student Characteristics Studies

A number of studies have attempted to determine the degree to which student interests influence the selection of vocational-technical curricula.

Interest scores and patterns of 9th and 12th grade students on the Minnesota Vocational Interest Inventory (MVII) have been studied in relationship to the selection of and adjustment to vocational high school training programs and subsequent employment (Barnette and McCall, 1963). Twelfth grade students in the foods, electrical, and printing trades showed the most valid profiles, that is, the highest MVII scores for students in other curricula were on non-criterion scales. Moreover, when the concurrent validity of the MVII was checked by comparing the proportion of boys in a given trade curriculum scoring high on the scales relevant to that trade with the proportion of boys outside the curriculum also scoring high on the scales, it was concluded that the MVII was somewhat more valid for 12th grade than for 9th grade boys. Most of the scores for 9th grade students were close to the tradesmen-in-general score of 40. Age differences, therefore, seem to influence the concurrent validity of the MVII more than race (Negro/white) differences.

A study by Silverman (1964) to determine whether high school and post high school students in eight trade and technical curricula could be differentiated on the basis of interest was conducted using a sample of students in Delaware, New Jersey, and Pennsylvania. The Hackman-Gaither Vocational Interest Inventory was administered to 2000 students enrolled in commercial, cosmetology, practical nursing, professional nursing, agriculture, automotive, drafting, and electronics programs. Significant differences in interests among all trade groups of the same sex were found. Male and female trade students were also significantly different from academic students of the same sex. Empirical keys constructed from the academic samples were found to be superior for differentiating between trade and academic samples, and the empirical keys developed for trade samples were found to be superior for differentiating among students in various trade groups in the study.

The appropriateness of discriminant function analysis for classifying trade and industrial education students (Doerr, 1967) was investigated by a study of the relationship between selected scores on aptitude and interest variables of the Dailey Vocational Test and MVII, and the selection of vocational-technical courses by 11th and 12th grade students. Curricular groups of vocational-technical education students were successfully differentiated using their two interest test scores (centroid's for eight vocational groups were statistically different); two of the seven potential discriminate equations exhausted 86.7% of the discriminate power of the 13 variables under study. Utilizing the maximum likelihood principle of classification, 46% of the valid sample could be correctly identified with the actual vocational group. More accuracy of prediction of group membership (63% and 72%) was possible using 2 or 3 of the largest probability values for each subject.

Summary

Figure 2 is a summary of studies of high school students reviewed in this section. It reflects a convenient capsulation of findings for approximate and somewhat arbitrary categories of independent variables, and indicates the relative emphasis of prior research (including general findings from Patterson and Prediger reviews), and fruitful areas for further investigation.

FIGURE 2

SUMMARY OF FINDINGS FOR HIGH SCHOOL STUDENTS

The practitioners' attention is directed to the apparent relationships among a) verbal ability and achievement, b) prior achievement and program completion and, c) interests and related student characteristics. Parental and societal influences suggest that, in general, high school students are a relatively "captive" audience. Thus it was not surprising to find more emphasis on student achievement than on program completion. However, relevant program completion data can also be found in the literature and research on school

dropouts. Verbal ability, I.Q., and academic ability (e.g., selected GATB and DAT scales) were found to successfully predict achievement. Prior achievement (grades) in mathematics or arithmetic, English and reading comprehension, as well as overall past GPA were related to both achievement and completion, while student interests have been used to discriminate among students in different high school vocational curricula.

The following questions are exemplary of persistent researchable problem areas: How do occupational perceptions and preferences influence program selection, achievement, and completion? Which biographical variables play a significant part in student success in training and subsequent on-the-job success? How are relevant student motivations and interests determined and measured, and how are they effected by guidance and training? Practitioners and researchers must increase their attention to these and similar problems and continue the development of theoretical constructs necessary to relate long-term research to their solution.

POST-HIGH SCHOOL STUDENT SELECTION AND THE PREDICTION OF STUDENT SUCCESS

Studies reported in this section had at least one element of commonality: they attempted to forecast the academic achievement of vocational-technical post-high school students using selected variables such as standardized test scores, inventories, biographical data and/or other related measures. Among the studies correlational and regressional techniques were the most frequently employed statistical methods.

Achievement Studies

The effect of industrial arts experience on achievement in selected post-high school trade and technical curricula was reported by Moss (1966). Number of industrial arts courses taken, grades in those courses, the relationship of industrial arts courses to chosen post-high school curriculum, and the purpose for which industrial arts courses were offered, were investigated to determine their effect on success in post-high school automotive, electrical, machine shop, and drafting programs. Twenty-seven variables were initially used in the regression equations, resulting in multiple correlation coefficients ranging from .63 for electrical to .83 for machine shop. The weighted regression analysis used to develop the ordinary multiple linear equations for predicting average earned grades reduced the maximum number of variables in any one equation to six and resulted in multiple correlation coefficients ranging from .47 for electrical to .72 for machine shop. The most efficient overall predictors of average earned grades were high school percentile rank (normalized) and intelligence. Success was measured by average earned grade, and completion rate. Moss concluded that differences in amount, content, and objectives of industrial arts experience had no observable influence on the scholastic achievement of students in the four curriculum clusters and that academic courses, particularly physical sciences, were apparently as effective in preparing those who took them for their post-high school program as industrial arts was for those who enrolled in it. However, achievement in senior high school industrial arts was found to have some influence on achievement in two of the post high school curriculum clusters. It is interesting to note that Whitten (1961) also found achievement in industrial arts to be significantly related to achievement in the secondary school vocational program.

Anderson (1966) investigated the usefulness of academic and biographical variables for predicting achievement in technical programs at the post-high school level. The criterion variable was the cumulative grade point average of graduates in each technical program (architectural drafting and estimating, civil engineering, electrical industrial drafting and design, refrigeration and air conditioning, and electronics) while the dependent variables consisted of five academic measures (The American College Test (ACT), Flanagan Aptitude Classification Test (FACT), Cooperative Mathematics Test, twelfth grade GPA, and the number of units in secondary school mathematics, science, and industrial arts) and seven measures of biographical data (age at enrollment, secondary school graduation, marital status, post-secondary school graduation, military status, parent's occupational level, and size of student's community). It was reported that the graduates of technical programs had more preparation in

mathematics and scored higher on ACT and FACT tests related to academic achievement than did the non-graduates. Academic variables showed appreciably higher relationships with achievement in technical programs than did biographical variables. Moreover, the graduates of selected technical programs possessed greater special aptitude skills (space relations, abstract reasoning, and creative and inventive problem solving) than did non-graduates. It was noted that, in general, the predictability of grades by multiple regression procedures varied among technical programs.

Development of multiple regression equations for predicting the first year grade point averages of students in an industrial drafting and design technology program was the purpose of an investigation by Dunn (1967). The independent variables consisted of measures on The Flanagan Aptitude Classification Tests (FACT) The American College Testing Program (ACT), and high school grades in English, mathematics, social studies, and natural sciences. Variables having the highest zero order correlations were Scales (FACT) .531, Mathematics (ACT) .531, Mechanics (FACT) .461, Natural Science (ACT) .401 and Patterns (FACT) .37. In addition, the highest multiple correlation coefficient (.67) for predicting first year GPA for students in the industrial drafting and design technology program consisted of a combination of the Scales and Mechanics tests from the FACT battery and the Mathematics test from the ACT battery.

A study of the use of high school records in predicting student success in trade, technical, and business schools (Livers, 1964) found that the most consistent predictors of performance in the various trade and technical training courses were academic factors (e.g. high school GPA and rank in class), while the best predictor of employer ratings of on-the-job performance was found to be high school GPA. The additional conclusion that success in trade and technical schools can be predicted better than success on-the-job when the predictor variables used are student characteristics from high school records tends to support the observations of Gishelli and others.

Samuelson (1956) used multiple correlation techniques to study the application of the General Aptitude Test Battery (GATB) for predicting success in selected trade school courses. Shop and theory rankings, combined into a single variable, served as the criterion measure. Aptitudes (from the GATB), multiple correlation coefficients, and the index of forecasting efficiency were reported in the findings. The courses for which the highest coefficients were reported were: (a) carpentry, R = .83: (b) electronics, R = .70 and (c) diesel mechanics, R = .66.

Karp (1966), in a study of first year private business school students, investigated the relationship between selected prognostic measures (aptitudes, abilities, and high school class rank) and first year academic success. He found that high school rank was the most important academic predictor (r = .63). A multiple correlation equation utilizing seven independent variables resulted in substantial predictive value (R = .63); the top three variables (high school rank, Verbal Reasoning, and Iowa Standard Reading Scores) of the seven independent variables yielded a multiple correlation of R = .61.

Swanson and Berdie (1961) studied the predictive validity of the Institute of Technology Math Test, Form Y using as a criterion the first quarter GPA of 620 freshmen entering the Institute of Technology at the University of Minnesota. When compared to other measures (high school rank; MSAT; Coop English, Form Z lower level; four part and Composite scores on the American College Testing Prog. Test; verbal and mathematics scores on the CEEB test) the IT Math Test was found to be the best single predictor of first quarter GPA.

A later study by Wattey (1964), at the same Institute of Technology, investigated change in predictive efficiency by introducing school-related factors into the regression equation containing the IT Math Test and high school rank. The school-related factors were size of school (50 or less, 51 to 100, 101 or more), and the kind of school (urban, suburban, private). Regression equations designed specifically for urban and private groups consistently predicted GPA with greater accuracy. It was concluded that students entering the Institute of Technology program from urban and private schools were sufficiently different from other groups of students investigated, in terms of academic predictability, to warrant use of separate regression equations.

Hoyt (1966) attempted to determine whether standard American College Testing data (test scores and selected high school grades) could be used as effectively to predict academic performance of students enrolled in two-year, terminal-occupational curricula as it could for those enrolled in other programs in junior colleges. The study sample was drawn from students enrolled in terminal-occupational curricula in two-year junior colleges selected from six states. Academic potentials for students in six occupational curriculums, estimated by standard ACT data, were related to overall college grades and grades in selected academic courses and comparisons were made with a national sample of freshmen from an all-college group (two and four year colleges), and with a national sample for two year colleges only. The six groups of terminal occupational students were reported to be "remarkably homogeneous" in terms of academic potential; high school grades were more indicative of this than ACT scores. Academic potential for the occupational samples, while only slightly below the general junior college average, were well below the all-college average with English and social studies being areas of greater weakness than mathematics and natural science. The grades of occupational students in selected academic courses averaged slightly higher than grades for the all-college and other junior college students. Caution was urged in interpreting this finding, however, since noticeable institutional differences in grading practices were observed. In general, the combination of ACT scores and high school grades, while they seem to have predictive validity for "non-academically" oriented students, were not as powerful a set of predictors as they were for academic students.

The measurement of and interrelationships among grades and psychological, sociological, and personality characteristics of College of Agriculture freshmen was the object of a study by Kittleson (1966). ACT mathematics standard

scores, high school rank, and the family relationships and conformity scales of the Minnesota Counseling Inventory were found to be the four most useful predictors of grades.

Like Moss (1966), McCracken (1963) investigated various aspects of the relationships among performance in selected junior-senior high school courses and post-high school achievement. McCracken found that the academic ability of students, as measured by quality point averages in high school and college courses, was more highly related to achievement in agronomy courses and academic achievement in college than was the number of semesters of vocational agriculture taken in high school.

A study of the variables which best predict the academic achievement of students in selected technical curricula, after they have had a preliminary, remedial, pre-technology semester was conducted by Brodsky (1964). Experimental (pre-technology semester) and control groups each consisted of twenty subjects matched on the basis of high school GPA, type of high school diploma, and enrollment in the engineering technician curriculum. An analysis of covariance for treatment groups with first semester technical curriculum GPA detected a statistically significant difference in favor of the experimental group. The best set of predictors derived from a step-wise multiple regression analysis were, Cooperative School and College Ability Tests (Form 1), remedial pre-technology semester GPA, faculty judgment of student maturity, faculty judgment of student motivation, student attitude toward the pre-technology program, attendance during the pre-technology semester, and high school science grade averages.

King, et al. (1959) developed a multiple regression equation (based on an N=30 from a total of 375 students) to predict academic success in a police administration curriculum. After the initial number of predictor variables (eight tests with 37 sub-test scales) was reduced to two, (Language Score on the California Mental Maturity Test and the total score on the Michigan State University Reading Test), a multiple correlation coefficient with overall GPA of R=.56 was computed.

A considerable body of information exists about the selection of students and prediction of success in nursing training. Ivanoff, et al. (1964) studied achievement, aptitude, and biographical data as predictors of success in nursing training, with the criterion for success being GPA at the end of the freshman year. Measures of the predictor variables employed in the regression equation were: (a) verbal and mathematics scores of the CEEB Scholastic Aptitude Test, (b) CEEB English Composition scores (c) high school rank, and (d) Life Experience Inventory (LEI) scores. The study reported that: (a) high school rank was the best single predictor of academic success; (b) high school rank was the first predictor variable to enter all regression equations; (c) the Life Experience Inventory appeared to explore unique criterion-variance over and above that presently accounted for by intellective tests and measures; and (d) biographical data can contribute to increased efficiency in predicting success under the described study conditions.

In a study of intellectual predictors of success in nursing school, Plapp, et al. (1965) compared the efficacy of three intellective predictors, (high school rank, Otis Quick Scoring Mental Ability Tests, and Scholastic Aptitude Test (SAT) of the College Entrance Examination), alone and in combination, to

forecast the performance of nursing students on the criteria of continuance, academic performance, and clinical performance. A major purpose of the study was to determine which of three generic measures of ability (past performance, general intelligence, or aptitude tests) showed greatest relation to each of the three criteria. Intellective factors were found to be effective for predicting first year dropouts, but were of negligible usefulness in predicting second year dropouts. The three measures correlated significantly with first quarter grades, but not with fourth quarter grades in academic courses, and SAT score was the only measure to correlate significantly with fourth quarter grades in clinical nursing courses. The results of the study raise questions about the assumption that the predictive power of tests remains constant over time and that prediction of academic performance can be equated with prediction of clinical performance.

In a series of studies of the correlations between various possible predictors and success in selected nursing training courses, Michael, et al. (1959) found that (a) tests in reading and vocation were statistically significant predictors of grades in nursing arts (methods) and pharmacology, (b) achievement tests in mathematics (fundamentals and problem solving) gave the single highest validity (.50) in predicting first course pharmacology grades, (c) certain speeded tests in perceptual and spatial aptitudes exhibited numerous statistically significant negative validities (-.20 to -.40) for four criterion variables, and (d) the MMPI Hysteria scale displayed significantly negative validity coefficients with clinical activity ratings and pharmacology grades (second course). Academic failures in the freshman year dropped from 40% prior to use of the tests to less than 10% after the tests were incorporated into the selection procedures.

In a later study of intellectual and non-intellectural predictors of success in nursing training, Michael, (1963) reported the additional findings that high school GPA was significantly related to success in physiology, microbiology and Nursing II, while for the most part intellective tests were not significantly correlated with the criteria. The California Reading Test (total score and Vocational part) was, however, significantly correlated with achievement in Anatomy and Psychology I-II, while high school GPA was not. Two particularly interesting findings were that ward performance was not well predicted by any of the measures studied, and that lower scores on the MMPI scales might be slightly more predictive of success in nursing programs.

A third study by Michael, et al. (1965) had as its purpose the determination of indices of predictive validity for cognitive and non-cognitive variables relative to twelve criterion measures (individual course grades and Nursing I and II grades). In general, the findings were compatible with those of prior studies, but this study found, in addition, that high school GPA in "solid-subjects" was the most valid predictor among all the variables studied (cognitive and non-cognitive), and was universally the most valid indicator of success in both academic and ward-performance phases of the training program. In general, indices of achievement in high school seem to hold at least modest promise for prediction of clinically oriented ward performance. The comprehension score on the California Reading Test was the most valid predictor of

grades in most courses, and the California Mathematics Test (fundamental) was the most valid indicator of performance in arithmetic courses. In general, scales of the MMPI were not substantially predictive of academic success or ward performance, and measures of spatial ability failed to yield even modest predictive validities.

Garrett (1960) used the Ohio State University Psychological Tests, Iowa Silent Reading Tests (advanced battery), George Washington University Series Arithmetic Test for Prospective Nurses, Minnesota Vocational Test for Clerical Workers, MacQuarrie Test for Mechanical Ability, Shipley-Hartford Retreat Scale, and high school GPA, to develop a regression equation to predict the average of all grades for the first year of a training program in a school of nursing. The best regression equation for predicting the criterion (R = .64) included high school GPA, Hunt Arithmetic Test, Iowa Silent Reading Tests, and Minnesota Vocational Test for Clerical Workers, with high school GPA contributing most to prediction.

A series of studies (Haney, et al., 1959, 1960, 1962) investigated variables related to success in nursing training. A factor analytic technique was utilized in the initial study with scores from fourteen aptitude and achievement tests compared to four criterion measures (grades in nursing arts, ward adjustment, anatomy, and pharmacology). The most highly weighted factors on the criterion variables were mathematics achievement, verbal comprehension, and lack of speed of manipulation of visually portrayed objects. In addition, an achievement and motivational pattern unique to the four course measures was found. The second study reported tests in reading and verbal abilities to be positively related to theory courses in anatomy and physiology, to nursing arts including pharmacology, and to ward performance ratings. Mathematics and reasoning tests showed some of the highest statistically significant validities with respect to nursing arts and ward performance, while speeded tests in spatial visualization and perceptual abilities showed positive validities with ward performance, and small but positive coefficients with the theoretical and laboratory aspects of courses in anatomy and physiology. Subscale scores of the MMPI did not yield validities significantly different from zero. The third study by Haney, et al. (1962) also examined achievement, aptitude, and personality measures as predictors of success in nursing training. Seven variables, consisting of course grades (anatomy, physiology, microbiology, medical and surgical practice - 2 parts) and class rank in hospital ward performance on each of nineteen items (patient care, initiative, dependability, etc.) on a Ward Performance Scale, served as the criterion. Achievement tests in reading and mathematics correlated significantly with formal course work but not with relative standing on measured characteristics of ward effectiveness. Speeded tests in visual and perceptual activities were not significantly related (in a negative way) to grades or ward performance. High school chemistry grades alone were slightly more predictive of grades in the four training courses than was overall GPA, and all nineteen items on the Ward Performance Scale were negatively correlated with the Hs scale on the MMPI (beyond the .01 level). An overall or global rating of ward effectiveness seems to be as effective an indicator of ward success as a score based on rank-order scores on each of several characteristics.

Gaza (1963) studied the use of the Interpersonal System of Multilevel Personality Analysis as a corollary to the usual selection procedure in the prediction of success in nursing training. The test battery of the Interpersonal System consisted of the Interpersonal Check List, the Minnesota Multiphasic Personality Inventory, and the Thematic Apperception Test. It was concluded that the Interpersonal System, as utilized in this study, failed to provide information directly relevant to the criterion of GPA.

Completion Studies

Studies of the prediction of success, as defined by completion of a program of instruction, have generally utilized similar instruments and methodologies as studies predicting achievement. However, interest measures and biographical data have been investigated more extensively in investigations of program completion. Far fewer studies predicting program completion were identified than studies predicting achievement.

The selection and guidance program used at Los Angeles Trade-Technical College was reported by Crawford (1964). The student application procedure at the college consists of two main parts, group testing and individual counseling. The testing portion is predicted on the belief that man has many kinds of intelligences which may be identified and measured by aptitude tests of relatively "pure" abilities. Aptitude test batteries especially prepared to predict success in fifty-five different trade-technical curricula and test norms have been developed over the fourteen years the program has been in operation. The counseling session which follows the testing involves both a trained counselor and an instructor from the trade or technical field in which the applicant has applied. Percentile scores on the tests have been developed and a 33rd percentile cutting score is used to select applicants. Applicants scoring at or above this point have generally been found to be good prospects for training while those scoring below have usually been referred to remedial work or given further counseling to help the applicant make a more appropriate occupational choice.

A study to improve the effectiveness of student selection for completion of industrial arts teacher education programs (Nelson, 1962) was initiated with the construction of special scoring keys for the Minnesota Vocational Interest Inventory (MVII). The interest patterns of competent, experienced industrial arts teachers were compared to those for Clarks' "Tradesmen in General" population to identify items for the scoring key which distinguished between the two groups. Freshmen in the Department of Industrial Education, University of Minnesota were then grouped into satisfied/dissatisfied categories on the basis of data from a personal information form and their MVII answer sheets scored using the special scoring key. Use of the special scoring key, along with data from the personal information form, enabled Nelson to distinguish students who possessed the same interest patterns as experienced industrial arts teachers from students who did not. It was proposed that students and potential students with interests similar to those of experienced, competent industrial arts teachers would be more likely to successfully complete the undergraduate program.

Taylor, et al. (1967) used interest, ability, and achievement variables in a study of success of male students enrolled in selected technical and associate degree college programs. To identify and compare differences and similarities among variables for students in various programs, and to determine which variables differentiate among students who complete, withdraw, or change programs, a sample of 941 students enrolled in Terminal Business, General Education-Science, General Education-Non-Science, Collegiate Technical, and Trade and Industrial programs were studied. With the exception of General Education-Science and General Education-Non-Science, all programs were two years long culminating in associate degrees or certification. In general, the variables studied differentiated among students enrolled in the selected programs. It was determined through factor analysis and subsequent analysis of variance tests that interests and interest-related factors best differentiated between students changing programs and those who completed or withdrew from college, whereas, ability factors were the best determinents of success in programs. The more heterogeneously grouped programs (Business and Collegiate Technical Curriculum) showed fewer significant relationships to factors than the more homogeneously grouped programs, (Trade and Industrial Programs), and ability factors were more effective predictors for programs of a higher or academic nature.

A descriptive study of sociological and psychological variables was conducted by Righthand (1964) in an attempt to distinguish technical institute freshmen dropouts and persisting students. Full-time male students at two state technical institutes in Connecticut who failed to return for the second year were defined as student dropouts and seventeen variables were studied (e.g., father's occupation, time and method of commuting, part-time employment, household income, student's concept of technician skills and work assignment, selected test scores). No significant differences between persisting and dropout students were found on the above variables, but the patterns of scores on ten standardized tests were different for the two groups (persisting and dropout) at each of the schools and for groups across schools.

PROJECT MINI-SCORE was initiated by Nelson and Pucel in 1965 for the purpose of identifying criteria useful in the selection and counseling of students enrolling in post-high school vocational-technical schools. The study, which will be conducted over a six year period (1965-1971), consists of four overlapping phases: (a) Testing all applicants to full-time, day trade programs in the twenty-seven Minnesota Area Vocational Schools, (b) recording the students' performance following testing, (c) follow-up of the graduates twelve months after completion (the project is currently in this phase), and (d) analysis and reporting of the data. The test battery for the study consists of (a) a personal information sheet, (b) the written portion of the General Aptitude Test Battery--Form B (GATB), (c) The Minnesota Vocational Interest Inventory (MVII), (d) the Sixteen Personality Factors Questionnaire -- Form C (16 PF), (e) The Minnesota Importance Questionnaire (MIQ), (f) The Vocational Development Inventory (VDI), and (g) The Minnesota Scholastic Aptitude Test (MSAT). Several "spin-off" reports have thus far been produced by PROJECT MINI-SCORE. One report (Nelson and Pucel, 1967) provided descriptive data on students entering the post-high school vocational institutions in Minnesota. Age, sex, marital status, educational background, prior vocational training, and previous work experience are among the data reported. Other reports have included a description of the instruments used to measure independent variables and to differentiate between groups of students

entering different programs (Pucel and Nelson, 1967), and the results of an investigation of data relative to interests, aptitudes, job needs,and personality factors, with a view to determining measures common to groups enrolled in different vocational programs (Pucel and Nelson, 1968). In addition, training success norms for the General Aptitude Test Battery (B 1002, Form B) have been developed and made available to the schools in the project (Pucel and Nelson, 1969). The norms, reported as percentile, stanine, and centour scores, are based on the students who have graduated from their respective curricula.

The relationship between factors selected from high school records, and occupational as well as college success, were investigated by Coppedge (1966). High School grade point average, composite score on the Iowa Test of Educational Development, (ITED), composite score on the American College Test (used only with college success), composite score on the California Test of Mental Maturity (CTMM), ratings of industry, ratings of initiative, ratings of responsibility (all from the confidential record), and teacher's prediction of college success were analyzed to determine their relationship to criterion variables defined as employer ratings and salaries (for occupational success) and college grade-point averages (for college success). The study showed no statistically significant relationships between occupational success and the selected factors, or between college success and the composite scores or the ITED and CTMM.

Broe (1962) conducted a study to determine the relationship between specific predictor variables and selected criterion measures of success in electronics training. Aptitude measures, biographical data, motivational characteristics, and personality characteristics were studied for their relationship to criterion measures of success defined as the sum-of-nine ratings, grade-received, and a composite criterion consisting of ratings of success in achievement-theory, achievement-lab applications, ability for precision work, persistence for details of work, ability to get along with others, ability to get along with the instructor, clarity of written work, comprehension of mathematics, and ability to learn from technical materials. The variables, predictor and criterion, were selected on the basis of the findings of prior research. The data were analyzed on the basis of the total group, first semester group, second semester group, second year group, and high and low achievers. While twenty-nine of the fifty variables were significantly related to the composite criterion, aptitude measures on the ten tests of the Employee Aptitude Survey (EAS) were generally more highly correlated with training success than were other predictor variables. The best predictor of training success for the total sample was the grade the student expected in the course. EAS tests (Verbal Comprehension and Numerical Ability), age in months, and number of units in progress gave a multiple R. of .75 at the first semester level of training; Symbolic Reasoning from the EAS battery, high school GPA, Social Responsibility, and Rigidity in Approach were the best predictors of success at the second year level of training (R = .53). Except for age and grade expected in course, the remaining biographical predictors were very low and/or nonsignificant contributors to successful prediction (grade expected was significantly related to success at all levels of training and clearly differentiated between high and low achievers). "How much" a trainee was interested in and motivated toward electronics was clearly related to success in training; it was demonstrated that high achievers had a higher degree of interest. Structured-Objective Rorschach Test (SORT) variables were low in relationship to the criterion, but Verbal Comprehension

plus Numerical Ability of the EAS battery were particularly valuable in predicting success at the first year level of training. It would seem that aptitude predictor variables were more promising predictors of success in training than are variables from personal history and personality characteristics, even though these non-intellectual variables should not be overlooked. The indicators from the EAS tests appear to be most relevant for the identification and guidance of students at the earliest levels of training, for increasing training efficiency, and in the guidance of students in electronics at all levels, including students who are at the level of wanting to enroll in the program.

Ritchie (1964) studied characteristics of students entering an engineering curricula for the purpose of identifying factors which could predict success. A further purpose was to construct a profile of the characteristics of engineering graduates from the School of Engineering. Thirteen variables, used in a discriminant function analysis, were applied to groups of graduates and dropouts, with several factors found to be statistically significant predictors of completion. Results of the study, used to construct Engineering Success Predictors, were reported for both native and college transfer groups of students. The five factors comprising the predictors for the native group were: (a) English Placement Test Score, (b) High school mathematics GPA, (c) Mathematics Placement Test Score, (d) high school recommending units, and (e) SCAT "T" scores. The predictors for the college transfer students were (a) Mathematics Placement Test Score, (b) high school mathematics GPA, (c) SCAT "Q" Score, and (d) transfer English GPA. It was reported that the discriminant function misclassified thirty to forty percent of the successful and unsuccessful students, respectively, when using these variables as factors in the analysis. However, the design of the Engineering Success Predictor compensated for the error. Profiles of the engineering graduates developed from the study showed the following characteristics: (a) they generally have military training, (b) were mostly self-supporting, (c) a large portion were married, (d) over half were 24 years of age or older at entry, and (e) approximately half took more than four years to complete their undergraduate engineering education.

Bojcun (1963) determined the specific attitudes and characteristics of pre-engineering freshmen for successful completion of the freshmen year in a community-junior college. A devised attitude inventory was given to groups of pre-engineering and non-engineering students from which a Selected Attitude Scale was made from the differentiating items. This, in turn, was used to differentiate among successful, failing, transfer, and dropout groups at the end of the freshmen year.

Related Student Characteristics Studies

Relatively few studies were found in this category. Samuelson (1958), however, studied interest scores as predictors of the success of trade school students. The relationship between scales of the Kuder Preference Record (KPR) and instructor judgement of student total performance was investigated. The sample was comprised of full-time students from six curricular areas. Instructor rankings of student performance included examination grades, quality and quantity of work in shops, and pertinent student personal characteristics.

Means on the Kuder scales (raw scores and percentile) showed a fairly flat profile. The Persuasive and Literary scales correlated negatively with instructor ratings at the 1% level and included the lowest levels of interest for ten scales. A pattern of interest showing a moderately negative position on the Persuasive and Literary scales identified the profile most closely related to the criterion of student accomplishment, but the relationships were of limited usefulness for predictive purposes (index of forecasting efficiency was about 9%).

In an attempt to validate the findings of Samuelson's study, Motto (1959) conducted a similar investigation to determine if significant differences existed on certain scales of the Kuder Preference Record between students who completed a vocational school program and those who entered but failed to complete. Eighty full-time students enrolled in trade courses at a vocational school comprised the sample, of which about 70% were disabled individuals and 65% were veterans. Two groups of forty each, randomly selected from examination of school records, were grouped on the basis of having completed or not completed the program. Means and standard deviations for the two groups were computed on the nine Kuder scales and percentile equivalents obtained. T-tests were apparently used to compare differences between groups. Findings, similar to those reported by Samuelson, indicated that the Kuder Mechanical scores were not related to performance in mechanical training programs (no significant difference in the mean scores for the two groups). A fairly flat Kuder profile was found, and none of the Kuder Performance Records scales significantly differentiated successful from unsuccessful vocational school trainees enrolled in ten different training programs.

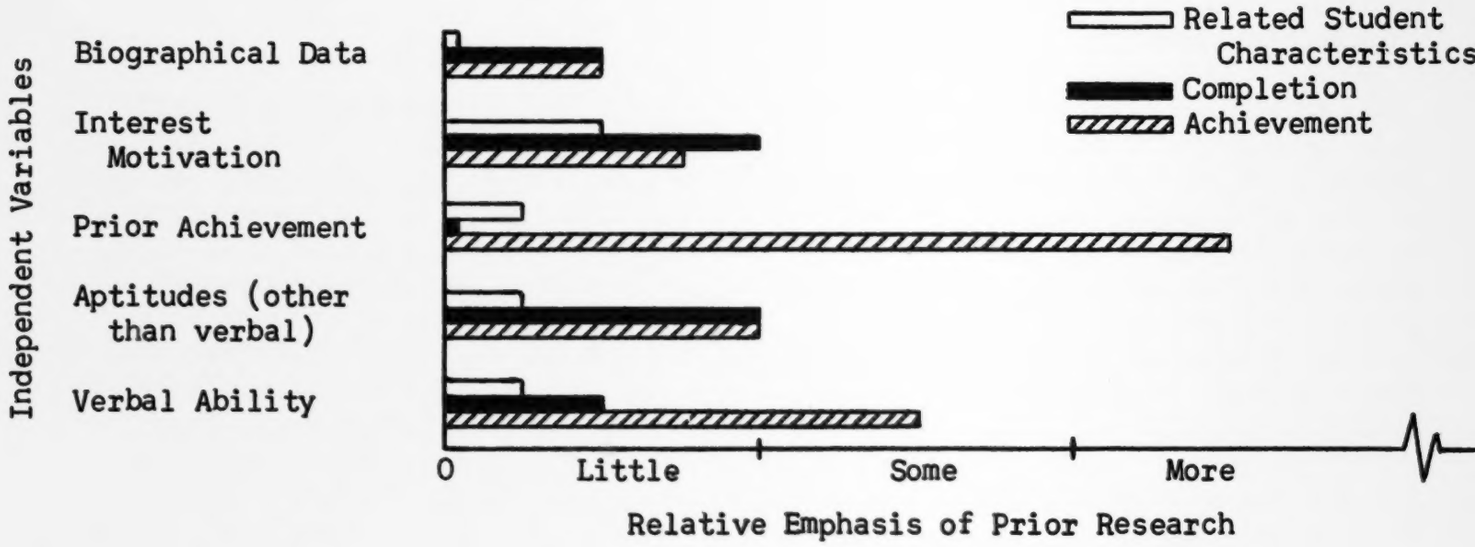
Hagemeyer (1961), in a study of manufacturing companies in Michigan, investigated factors considered in the selection of apprentices. Standardized tests were used by many large companies as an initial screening device, whereas most small companies made selections without knowing the applicants' potential, as indicated by scores on mechanical aptitude, mental ability, and specific skills tests. Neither company seniority nor family relationship were prime requisites for acceptance into apprenticeship training. Manipulative skills and a good work experience record were considered valuable by employers, and hobbies showing interest and aptitude in mechanical pursuits were also considered important. School recommendations, and the recommendations of previous employers were considered valuable, but relative success in school was thought less important than graduation.

Summary

Figure 3 summarizes the relative emphasis of prior research (including general findings from Ghiselli and Patterson reviews). Apparently, prior school achievement was related to program achievement, and aptitudes as well as interest and motivation appeared to have some relationship to program completion. Related student characteristics appeared to be the least investigated area. With the increased demand for training and short supply of vocational staff and facilities, greater research efforts should probably

FIGURE 3

SUMMARY OF FINDINGS FOR POST-HIGH SCHOOL STUDENTS



be directed toward problems of program completion. Problems related to the selection and guidance of students into programs which minimize transfer among programs and facilitate program completion should be investigated. The relationship between prior achievement and program completion would seem to be one profitable area for study in this regard. At the post-high school level, more attention needs to be directed toward the possible relationship between training success and on-the-job success.

ADULT STUDENT SELECTION AND THE PREDICTION OF STUDENT SUCCESS

Completion Studies

Little (1965) conducted a follow-up study of 3000 Wisconsin high school male graduates to ascertain their post-high school education and occupations seven to eight years after graduation. The sample represented twenty percent of the male graduates of the state for 1957. Comparison of follow-up data with information which had been provided prior to graduation indicated that more graduates than had originally planned (11%) attended some type of post-high school institution. Almost twice as many attended vocational schools as had initially indicated; in addition, college attendance was also more frequent than planned. College-going students were predominantly high ability graduates with a comparatively high socio-economic status, whereas vocational school students were a cross-section of the graduates, with all levels of ability and background represented. Those not attending any type of school were mainly from rural areas. A definite relationship was found between levels of occupations attained and level of formal schooling acquired, and in general, occupational attainments were consistent with occupational aspirations expressed at the time of high school graduation. In conclusion, it was observed that "It is clear that among many youth of equal ability and scholastic achievement, it is a distinct advantage to have well-educated parents who are established in high prestige occupations, and to live in a large community where colleges are present and job opportunities are comparatively varied and plentiful. There is good reason for many able youth in rural and smaller communities to be migrating to the cities."

An investigation by the U.S. Department of Labor, Manpower Administration (1967) summarized available data relative to the validity of Employment Service Aptitude Test Batteries for predicting success in MDTA training. Samples included in the study were selected on the basis of the following criteria: (1) a Specific Aptitude Test Battery (SATB) for the occupation trained for had previously been developed from research on employed workers or trainees and was in operational use in Employment Service local offices, (2) the SATB was administered at some time before or during training, but was not used in the selection of the trainees and (3) a total of at least 40 individuals comprised the MDTA training sample. The experimental test battery used SATB norms developed from employed worker or trainee sample data. Each SATB consisted of a combination of GATB aptitudes with appropriate cutting scores. Examinees were required to equal or exceed cutting scores in the SATB in order to qualify, with pass or fail serving as the outcome. The success criterion for each of the trainee samples was instructor ratings on various aspects of the course work. The results of the study showed that aptitude test batteries used by local Employment Services offices had validity for making predictions of success for MDTA training candidates. However, the magnitude of relationships between aptitude norms and training success indicated that, in addition to aptitudes, other factors were important.

Pucel (1968) undertook a study of MDTA trainees to determine which combination of personal information and GATB scores most efficiently predicted whether trainees dropped, completed training and were unemployed, completed training and were employed in an unrelated occupation, or completed training and were employed in a related occupation. A further purpose of the study was to determine which combination of teacher ratings of attitudes and achievement could most effectively predict the foregoing. The study used students enrolled in ten MDTA projects, purposively selected from 105 MDTA programs in Minnesota, on whom complete data were available. Subjects were grouped into three occupational areas: technical (N = 45), sales and clerical (N = 45), and skilled (N = 48). Data in three broad categories, personal and training related characteristics, in-school instructor ratings of attitudes and achievement, and post-training employment data (success criteria), were analyzed using a step-wise linear regression technique. The seven most important personal and training related characteristics and instructor rated attitudes and achievements for each sample were identified. Differences between the sales and clerical group and technical and skilled group were found; success in sales and clerical had a higher relationship with skill and technical information at entrance to the program, while success in the technical and skilled groups was more related to what the trainees possessed when they left training. Both skill and attitude were related to successful employment and each independently contributed to the possibility of successful employment. Pucel concluded that different selection criteria are necessary for trainees in different types of occupational programs, and techniques for appropriate attitude building should be a conscious and planned part of training program rather than an unplanned by-product of training.

Thorndike (1963), in a review of an earlier report, 10,000 Careers, examined the feasibility of predicting occupational success over long periods of time by means of a uniform test battery. 10,000 Careers was a study of men tested with a uniform aptitude battery when they were applicants for air crew training during World War II. A follow-up study of 17,000 men (an approximately random sample drawn from a group of 75,000 men tested late in 1943 on one uniform battery) was conducted on selected aspects of their post-war occupational history. The question, "Can tests given at about age 20 predict occupational success 12 years later?" was clearly answered "NO" by Thorndike who concluded that perhaps attention should be given to more immediate and limited objectives in testing and in counseling. A number of propositions offered by Thorndike to explain the results of the study are of particular experimental concern to researchers and interested practitioners:

> (1) The groups had been pre-screened and so were too homogeneous to yield significant differences and relationships. (2) The tests were inappropriate for civilian jobs. (3) Ability tests picked because they have predicted success in training are of no value for predicting success on the job. (4) The tests were not sufficiently pure and homogeneous measures to bring out occupational differences. (5) The tests were too limited in the range of attributes that they covered and missed the really crucial ones. (6) Specific abilities of the type included in the Air Force Battery show too little stability over time to permit useful prediction. (7) The occupational groups were so heterogeneous that no differentiation or prediction was possible. (8) Occupational success

was not adequately evaluated, and so could not possibly be predicted. (8A) Beyond survival in an occupation, "success" depends so heavily upon contingency factors that one can never hope to predict from what can be known about the individual in advance.

Related Student Characteristics Studies

Ronan (1964) conducted an evaluation of skilled trades performance predictors as they related to the following four performance factors for skilled tradesmen: I) injury index (lost time accidents), II) school rating (math grade), III) supervisor's rating (promotions, disciplinary actions), and IV) personality disorder (absence index, shop rating, and grievances). Predictor variables were of four main classes, personal history, aptitude, personality, and interest. The sample consisted of applicants admitted to skilled trades apprenticeships in a machine company during the years 1947-1957. Their age at time of admissions was 18-32 years, whereas at the time of study it ranged from 28-42. Thirty-seven of 172 correlations were significant at the .05 level (8 of 32 personal history items, 15 of 52 aptitudes, 6 of 52 personality, and 8 of 36 interest measures). Interest was important as an occupational entry variable, particularly in the skilled trades, however, all significant correlations with the Kuder Preference Record - Vocational were negative and reputed the hypothesis that successful performance over long time periods depends more on interest than ability. The breakdown of correlations by factors (I, II, III, and IV) and level of predictability disclosed seven significant correlations with a high level of predictability for Factors I, fourteen and thirteen significant correlations for Factors II and III respectively, and three significant correlations, probably not useful for prediction, for Factor IV. Personality measures were comparatively poor as predictors, and, in general, could be eliminated from test batteries devised to predict craftsman job performance.

Sorenson (1965) investigated methods of prediction in a study comparing linear and configural analysis as predictor models. Sales success was predicted using biographical background data from a national sample of salesmen from a large firm. The results of the study indicated that configural prediction was more efficient than linear analysis.

An investigation of cross validation procedures for selecting life insurance salesmen was reported by Merenda, et al. (1961). A sample of 535 ordinary life insurance agents was used to cross-validate a selection system originated earlier on 522 agents in the same company. Three predictor variables used in the study were personality profile measured by Activity Vector Analysis (AVA), a set of five personal history variables (number of children, education level, number of offices held, monthly living expenses, and amount of insurance owned), and age of agent; criteria were 3-year agent success-failure, determined on a multiple criterion basis including agent production and company status, and dollar amount of face value of life insurance sold. A discriminant function analysis was used to identify groups, with potential failure defined as obtained scores falling below critical scores on two predictor variables. AVA was found to be a valid predictor of success/failure among life insurance agents. Certain personal history measures were also found to be valid predictors, but age was

not, and the combined AVA and personal history data enhanced the predictive efficiency of success/failure of agents over a sustained period of time.

A study of work satisfaction as related to scores on a picture interest inventory was reported by Geist (1963). The Geist Picture Interest Inventory (GPII) and the Hoppock Job Satisfaction Survey were administered to men in six different occupational groups and correlations computed. The scales of the GPII appear to be valid (with the exception of clerical and outdoors); median correlations of the valid scales ranged from .21 (social workers) to .87 (artists). The two most prominent reasons given for work satisfaction were "freedom" and "intellectural stimulation", and the two most prominent reasons for dissatisfaction were "lack of appreciation by colleagues and administrators" and "bad physical working conditions."

Several studies have investigated the predictive validity of the Strong Vocational Interest Blank. Berdie (1960) compared three groups of university graduates (medicine, law, and accounting) using SVIB scores obtained in grade 12. The study showed significant differences in the scores and profile patternings of the three groups. Statistically and practically significant relationships for each of the groups of graduates were found between 12th grade SVIB scores and their later occupations. While some men entered and presumably remained in occupations in which their SVIB scores were low, most men were in occupations related to 12th grade SVIB scores.

In a later study, Berdie (1965) followed a similar procedure using graduates in dentistry, mechanical engineering, architecture, and journalism. Comparisons were made among each of the four groups and also between the three groups from the previous study. The findings of this study were, in general, similar to the prior study, that when carefully used, the SVIB can serve a valuable guidance and counseling function with high school seniors.

High scores on the life insurance salesman scale of the SVIB were studied by Campbell (1966) in relationship to eventual adult occupation. A follow-up of high school seniors who graduated in 1953 and 1954 with "A" ratings on the SVIB life insurance salesman scale was conducted to see what occupation they were in. The results of the study showed that, in terms of occupations in the sales area, "there is a substantial relationship between high scores on the SVIB and eventual adult occupations."

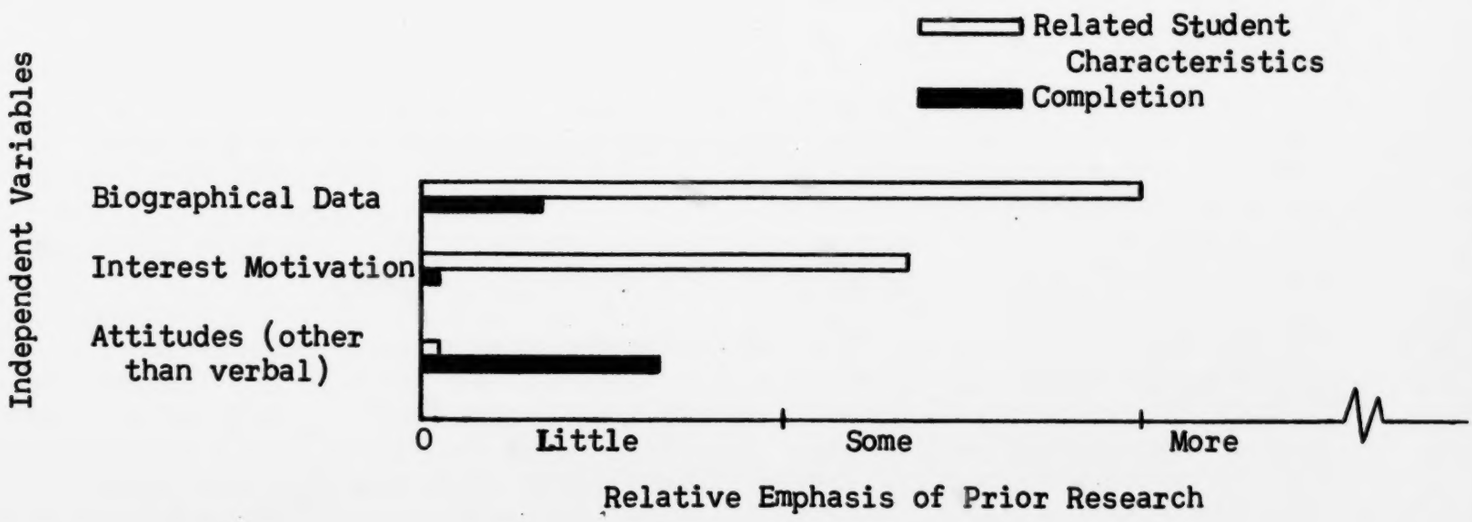
Schletzer (1966) used the SVIB in a study of the relationship between job satisfaction and interest appropriate to a particular occupation. One hundred and eighty-five university graduates of professional curricula (medicine, law, dentistry, mechanical engineering, accounting, and journalism) were asked to complete three job satisfaction blanks and the SVIB. In addition, twelfth grade SVIB scores were available for each subject. Analysis of the data revealed that job satisfaction was not related to congruent interests or to interests appropriate to that occupation.

Summary

The summary of the findings of the review regarding adult vocational-technical students reflects the apparent paucity of research in the problem area. While each of the three program outcomes need to be investigated, and few, if any, significant conclusions can be reached, it should be pointed

FIGURE 4

SUMMARY OF FINDINGS FOR ADULT STUDENTS



out that data relevant to adult vocational training can also be found in the research literature on worker adjustment, training of the disadvantaged, and MDTA programs.

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